

# DIVISION OF FOREST PEST CONTROL



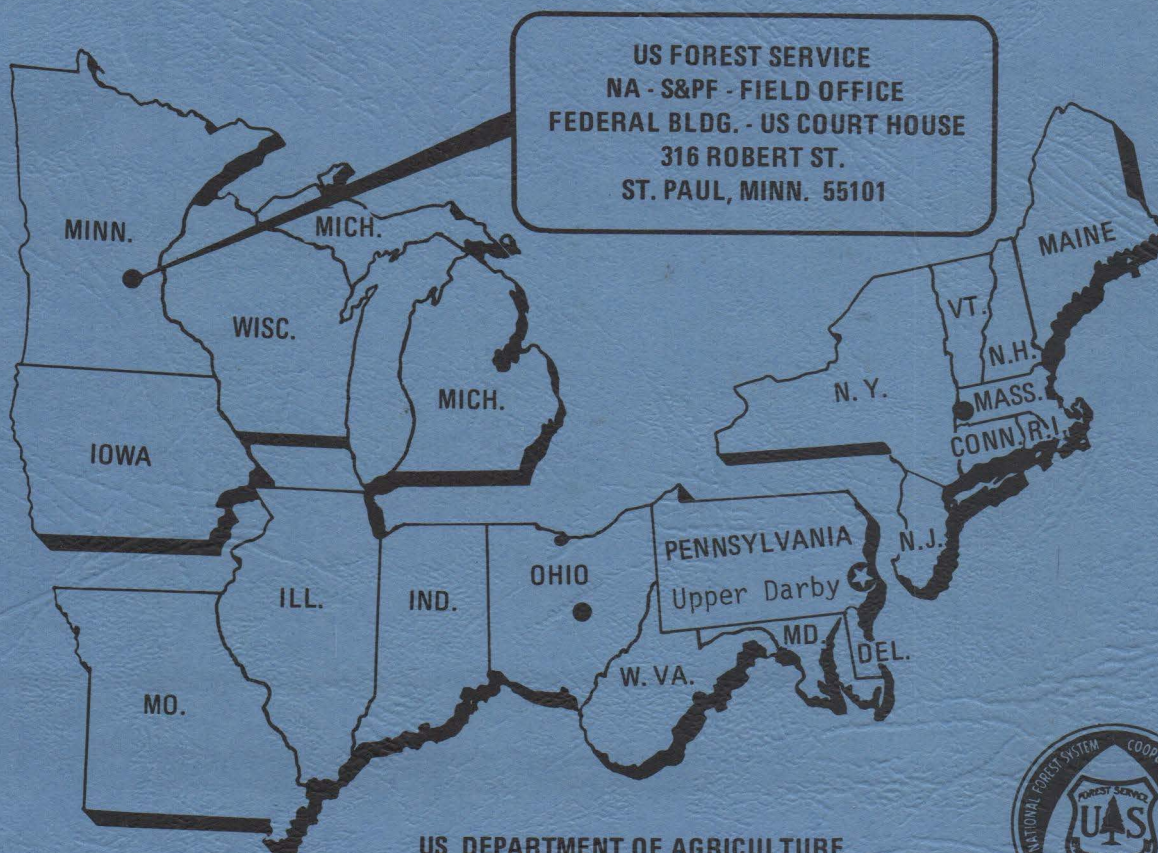
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EVALUATION OF RED PINE CANCKER  
ON THE CHIPPEWA, HURON-MANISTEE  
AND SUPERIOR NATIONAL FORESTS

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FOREST SERVICE

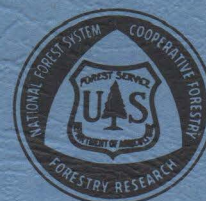






Figure 1. Minnesota "Pine Canker" (at arrows) on plantation stock. A. Live cankered trees, healed (injury not visible before cutting). B. Live cankered trees, incompletely healed. C. Dead cankered trees.



Figure 2. Michigan "Pine Canker" symptoms on nursery stock. Injuries are under bark near dead needles.



EVALUATION OF RED PINE CANKER  
ON THE CHIPPEWA, HURON-MANISTEE  
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By

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SUMMARY

In 1966, serious losses occurred in red pine plantations established in the fall of 1965 and the spring of 1966 on the Chippewa and Superior National Forests in Minnesota. Subsequent examinations at the Eveleth Nursery revealed that many seedlings were internally lesioned or girdled, suggesting the name "pine canker". A similar problem caused high losses at the Chittenden Nursery at Wellston, Michigan, and in plantations on the Huron-Manistee National Forests. At first the Minnesota and the Michigan pine cankers were considered the same, but indications now are that they are different. The causes of the maladies have not been determined.

Permanent plots were established in plantations to determine whether the maladies spread to unaffected seedlings in the field, and to determine the mortality caused by them. The plots were established on the Chippewa and Superior National Forests in Minnesota in 1966 and on the Huron-Manistee National Forests in 1967, in plantations planted in the spring of 1965, fall of 1965, and spring of 1966. A supplemental study was undertaken in 1968 to test the reliability of the plot findings.

The results indicate that the Minnesota canker spread or intensified in the field but caused no mortality. In comparison, the Michigan canker probably did not spread to unaffected trees when the trees were outplanted, but mortality of affected trees was extensive, at least when the trees were planted on open, unshaded sites.

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1/ These studies were conducted by Northeastern Area, Forest Pest Control, State and Private Forestry in cooperation with the North Central Forest Experiment Station, and Region 9, National Forest System.



## INTRODUCTION

In 1966, severe seedling losses occurred in the red pine plantations established in the fall of 1965 and spring of 1966 on the Chippewa and Superior National Forests in Minnesota. Subsequent examinations at the Eveleth Nursery revealed that about 10 percent of the 3 year-old seedlings had small lesions beneath the bark of the stem close to the ground line (Dolgaard, 1966).

A 1966 survey of red pine plantations established since 1956 revealed that many outplanted trees had external stem lesions. These lesions were rather large cracks, often filled with pitch and being healed over with callous tissue (Figure 1, inside front cover). About 23 percent of the trees examined on the Superior and about 7 percent of those on the Chippewa were affected. The lesions were found on trees planted as early as 1956. (See Appendix I for more detailed information on the survey). It is not known whether the nursery lesions and those found in the field are related.

A similar problem caused serious losses at the Chittenden Nursery, Wellston, Michigan in 1966. Affected seedlings had internal lesions or girdles on the main stem at the base of the older, dead needles (Figures 2 inside front cover and 3 inside back cover). A cursory examination of 1965-66 plantations on the Huron-Manistee National Forests revealed that seedlings affected by this malady had also been planted in the field, and tree mortality had occurred.

A 1966 survey of 1-10 year old plantations on the Huron-Manistee revealed that many trees had stem lesions or girdles. The condition was seldom found in plantations older than three years. This injury appeared either as a lesion partially girdling the stem or as a complete stem girdle (Figure 4 inside back cover). If an injury extended beyond half the circumference of the stem, the tree usually died. Trees less extensively damaged often survived and the injury healed. Girdled trees that had died often had a swelling above the girdle, indicating that food production had continued in the crown for some time after the phloem had been killed (Figure 4, C - first tree from left).

At first, the Minnesota and the Michigan maladies were considered the same. This led to the adoption of the inclusive term "pine canker" to designate the problems. However, indications now are that they are different, and they are herein separated by the name of the locality where found.

The causes of the maladies have not been determined. Several fungi were isolated from cankered and lesioned areas on the Minnesota seedlings, but their pathogenicity has not been established. 2/

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2/ Isolations by Neil Anderson, Plant Pathologist at the University of Minnesota



At first, the fungus Scleroderris lagerbergii Gremmen was thought to be responsible for the Michigan problem, but it could not be isolated from nursery stock. 3/ Adverse climatic factors may be involved in one or both of the problems, but this is not confirmed. The Michigan malady closely resembles that described by Peace (1962) under heat injury, but the typical injury appears to be rather high on the stem for hot soil to have caused it.

#### OBJECTIVES

The objectives of the pine canker evaluation are:

1. To determine whether "pine canker" spreads to unaffected stock within selected red pine plantations on the Chippewa, Superior, and Huron-Manistee National Forests.
2. To determine the extent of tree mortality caused by "pine canker" within these plantations.

#### METHODS AND PROCEDURES

Permanent, twentieth-acre plots were established on the Superior and Chippewa National Forests (Minnesota plots) in 1966 and on the Huron-Manistee National Forests (Michigan plots) in 1967. The plots were placed in red pine plantations planted in the spring of 1965, fall of 1965 and spring of 1966. Two plots in each of 12 plantations were established on the Chippewa, and 2 plots in each of 15 plantations on the Superior. The Superior plantations are all on open sites - i.e., without overstory. The Chippewa plantations have at most a light overstory of aspen sprouts. On the Huron and Manistee, 3 plots per plantation were established in 24 plantations (12 on each forest). Two covered plantation sites, i.e., underplanted, and two open sites were selected for each of the three planting seasons for each Forest. All plots were marked with corner stakes, and maps were prepared to show locations of the plots and trees within the plots.

Condition class (healthy, poor vigor, dying or dead) and symptom class (discolored or missing foliage, absent or stunted candles, dead or absent buds, stem cankers) of each tree were determined at the time of plot establishment. The Minnesota plots were re-examined in 1967 and 1968 and the Michigan plots in 1968.

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3/ Isolations by Darroll Skilling, Plant Pathologist at the North Central Forest Experiment Station.



Analysis of the 1967 data suggested that the observation of gross external symptoms might not be a reliable indication of damage. Therefore, a supplemental study was undertaken in 1968 to test the reliability of the plot observations. Ten trees in the vicinity of each plot were classified in the same manner as the plot trees and later dissected in the laboratory. (See Appendix II for methods.)

### RESULTS AND DISCUSSION

Table 1 shows the percentage of trees found cankered at each examination of the plots. On the Chippewa and Superior plots an apparent increase in the percent of trees cankered occurred between the 1966 and 1967 examinations and a very slight decrease between the 1967 and 1968 examinations. On the Huron-Manistee plots a very slight increase apparently occurred between the 1967 and 1968 examinations. The same trees were examined annually, but by different crews, so the changes could be due to classification errors.

TABLE I Percent of Trees Found Cankered on the Pine Canker Plots--  
1966-68 Field Examinations

Forest	Trees Examined	Percent of Trees Cankered		
		1966	1967	1968
Superior	1195	1.3	2.4	2.3
Chippewa	935	13.6	14.8	14.7
Huron	1404	----	6.2	6.3
Manistee	1437	----	10.5	10.6

Table 2 shows the results of the supplemental study in which trees adjacent to the plots were similarly classified in the field and later dissected in the laboratory. Clearly there is enough error to explain any changes based on observation of external symptoms. Therefore, the plot data is not a reliable indication of spread.



TABLE 2. Differences Between Percent of Cankered Trees as Observed in Field (gross external symptoms) and in the Laboratory (after dissection)

Forest	Number of Trees Examined	Percent of Trees			
		Judged Cankered (Field Observations)	Having Cankers that were Correctly Identified	Having Cankers that were Overlooked	Actually Cankered (Lab Observations)
Superior	300	16 a/	10	6	16
Chippewa	240	18	15	8	22
Huron	360	6	4	8	12
Manistee	360	9	5	10	15

a/ The Superior trees examined in the supplemental study had a much higher percentage of cankering than those on the plots (see Table 1). The reason for this is not known.

The age of the trees when the cankering occurred would better indicate whether previously unaffected trees were damaged after outplanting. Cankers on trees dissected in the lab were examined to determine when (as nearly as possible) the cankers were formed by noting their positions in relation to the annual rings. The results are presented in Table 3.

TABLE 3. Tree Age at which Cankering Occurred as Determined from Annual Rings

Forests	Number of Cankers Examined	Percent of Cankers formed on Trees			
		Younger than 3 Years	3 Years Old	Older than 3 Years	Total
Chippewa & Superior	83	16	32	52	100
Huron-Manistee	91	24	68	8	100

In the Minnesota plantations approximately half of the cankers were formed after the trees were outplanted (at 3 years of age). In Michigan, few cankers (or similar injuries) occurred after the trees were three years old, and about one fourth occurred before they were three years old. These data indicate that the Minnesota canker spread or intensified in the field while the Michigan canker probably did not.



Indications are that the Michigan canker caused mortality, but there is no evidence that the Minnesota canker did. Mortality data for cankered and non-cankered trees examined in 1967 and 1968 is presented in Table 4. The differences in the Minnesota percentages (18 compared to 13 percent, 9 compared to 15 percent) are probably due to sampling error.

Table 4. Comparison of the Mortality of Cankered and Non-cankered Trees

Forest	Non-Cankered		Cankered	
	Number Examined	Percent Dead	Number Examined	Percent Dead
Chippewa	673	18	137	13
Superior	1021	9	27	15
Huron*	732	40	74	97
Manistee*	636	17	119	67

\*Open sites only.

It is not likely that the canker was beneficial to trees on the Chippewa, as the data suggests, and only 27 cankered trees were found on the Superior (thus a small change in number of dead would result in a large change in percentage dead). The difference between the mortality rates of Michigan cankered and non-cankered trees is exaggerated because according to the supplemental study many of the cankers on live trees were overlooked or were not visible before the trees were dissected (Table 2). However, adjustment for observational errors (using the dissection data in Table 2) still leaves considerable difference between the mortality rates, e.g. on the Huron the mortality rate for non-cankered trees becomes 41 percent rather than 40 percent and that for cankered trees 74 percent rather than 97 percent (for method of calculation, see footnotes to Table 6. Substitute "non cankered" for "cankered" to calculate rate for non-cankered trees).



The surveys indicated that overhead cover or shade reduced the mortality of newly planted trees. This inference was tested on the Huron-Manistee by placing half the plots in sheltered plantations. Table 5 shows that when the trees were dissected, there was no difference in the number of trees cankered in open and sheltered plantations (which

Table 5. Comparison of Michigan Plot Observations with Samples adjacent to Plot Similarly Classified and later Dissected.

Forest	Exposure	Plot Observations		Off-Plot Observations		
		Number of Trees Examined	Percent Cankered	Number of Trees Examined	Percent Cankered (Field)	Percent Cankered (Lab)
Huron	Open	806	9	180	8	12
	Covered	598	3	180	4	12
Manistee	Open	755	16	180	13	14
	Covered	682	4	180	5	16

when added to findings presented in Table 3, indicates that the damage occurred in the nursery). However, a tree, cankered or non-cankered, was more likely to die if there was no overhead cover (Table 6).

Table 6. Comparison of Tree Mortality in Open and Covered Plantation

Forest	Exposure	Total Trees	Percent Dead	Plot Observations		Computed Estimate	
				Trees Cankered	Percent Dead	Trees Cankered <u>a/</u>	Percent Dead <u>b/</u>
Huron	Open	806	45	74	97	97	74
	Covered	598	13	15	80	72	17
Manistee	Open	755	25	119	67	106	75
	Covered	682	11	33	48	109	15

a/ Total trees x percent dissected trees cankered = estimated trees cankered

b/ Actual dead trees cankered/estimated trees cankered = estimated percent dead.



The plot observations indicate that the chances that a cankered tree in the open would die were only slightly greater than those of the trees under cover. However, when the data are adjusted for observational errors by using the lab dissections to estimate the true number of cankered trees, the chances are 4-5 times greater. The fact that cankers were more difficult to detect on trees in the sheltered areas suggests that a damaged tree healed more readily and quickly when provided overhead cover.

#### CONCLUSIONS

Of the Minnesota malady, (Chippewa-Superior) the following can be concluded:

1. The number of damaged trees increased after the trees were outplanted. Whether this is the result of the same conditions that caused damage in the nursery is not known.
2. The damage found in the field caused little, if any, tree mortality.

Of the Michigan malady, (Huron-Manistee) the following can be concluded:

1. The injury occurred in the nursery and there is little evidence of spread to unaffected trees when the trees were outplanted in the field.
2. Girdled trees died, and partially girdled trees often did, particularly when they were planted where environmental stress was apparently intense, such as in open, unshaded areas.
3. Damaged trees healed more quickly and readily when they were underplanted.

#### RECOMMENDATIONS

1. When compatible with other management practices, provide partial overhead cover for outplanted young pines, particularly when canker damage has occurred in the nursery.
2. If damage again occurs in the nursery, Research and Forest Pest Control personnel should be notified immediately, so that efforts to find the causes of the pine cankers can be continued.



## REFERENCES

Dolgaard S. J. Forester, Div. of TM. A letter to the record dated 9/1/66 and filed at Milwaukee, Wis. File #2470.

Peace, T. R. Pathology of Trees and Shrubs. London: Oxford Univ. Press 1962

## ACKNOWLEDGEMENTS

1. The study plan for this evaluation was written by Charles E. Cordell, Pathologist, formerly with Milwaukee Zone, Northeastern Area, now with the Asheville Zone, Southeastern Area, S&PF.
2. The plots on the Chippewa and Superior National Forests were established by NFS personnel under technical supervision of S&PF.
3. Establishment and the 1968 examination of the Huron-Manistee plots, and the 1967 and 1968 examinations of the Chippewa and Superior Plots were accomplished by S&PF personnel.



# APPENDIX I

## 1966 SURVEY OF 1-10 YEAR OLD RED PINE PLANTATIONS ON THE CHIPPEWA AND SUPERIOR NATIONAL FORESTS

OBJECTIVE: The survey was originally conducted to determine whether Scleroderris canker was present in National Forest pine plantations in Minnesota, and, if so, the damage caused by this disease. When the "pine canker" was discovered, and no Scleroderris canker, the objective became to determine the extent of this malady.

METHODS: A minimum of five plantations per Ranger District was surveyed. An additional plantation was included for each 500 acres of red pine plantations less than 10 years old on the District. At first, 50 trees in each plantation were examined for Scleroderris canker. Therefore, in a few plantations only 50 trees were examined. The other canker was soon noticed, and most of the plantations were surveyed systematically, using 20 tree plots (missing trees - i.e., empty planting spaces - were counted) at 5 chain intervals along lines 5 chains apart.

Appendix Table 1. Results of 1966 Survey of 1-10 Year Old Red Pine Plantations - Chippewa and Superior National Forests. Missing trees are excluded from data.

Chippewa National Forest					Superior National Forest				
Year Planted (Fall-Spring)	Plantations Examined	Trees Examined	Percent Cankered	Range (By Plan- tation)	Year Planted (Fall-Spring)	Plantations Examined	Trees Examined	Percent Cankered	Range (By Plan- tation)
56	2	223	2	0-2	57	1	50	8	-----
57	3	518	1	0-3	57-58	7	416	21	2-36
57-58	2	208	4	3-8	58-59	10	1083	11	0-45
58-59	2	224	13	4-19	59-60	8	908	30	14-60
60	3	407	3	0-7	60-61	7	1043	36	3-50
60-61	7	905	4	0-12	61-62	14	1508	26	0-71
61-62	10	1205	7	0-14	62-63	15	2171	28	4-85
62-63	6	1289	11	0-27	63-64	6	780	16	0-70
63-64	7	1352	10	1-27	64-65	13	1510	18	3-56
65	4	676	5	4-6	65-66	5	527	2	0-7
65-66	2	78	0	----					
TOTAL	48*	7085	7	0-27	TOTAL	86*	9905	23	0-85

\*9 Plantations had no cankered trees

\*8 Plantations had no cankered trees



## APPENDIX II

### SUPPLEMENTAL STUDY TO TEST FINDINGS ON PINE CANKER PLOTS

#### Objectives

The laboratory dissection was made:

1. To compare the presence or absence of canker as revealed by field observation of gross external symptoms with its presence or absence as revealed by laboratory dissection.
2. To determine when (in what year) trees were cankered.

#### Methods

The permanent plots already installed were used as a basis for a systematic sampling method as follows: If the trees were in rows, the rows on the plots were extended beyond the plot edges and sample trees taken from them. If the trees were not in rows, a compass line from the plots was established, and sample trees taken from along the line. Each sample tree was classified according to the plot scheme first, then removed for later laboratory dissection. Ten trees were removed near each plot on the Superior plantations (2 plots each), and ten trees near each plot on the Huron-Manistee plantations (3 plots each).

Alternate trees were sampled to avoid creating large gaps in the stands. Only trees actually present (living or dead) were sampled - i.e. missing trees were not considered.

In the laboratory, the sample trees were shaved down with a knife to expose any internal damage. Time of cankering (if any) and subsequent healing were determined by noting damage in relation to growth rings. The dissected trees were classified as follows:

1. Never cankered
2. Cankered (year) and healed
3. Cankered (year) and not healed

These data were then compared with observations of gross external symptoms of the same trees in the field.





Figure 3. Michigan "Pine Canker" symptoms on nursery stock. Bark removed from trees in Figure 4. Note discoloration, especially pronounced at center of bottom tree.



Figure 4. Michigan "Pine Canker" (at arrows) on plantation stock. A. Live cankered trees, incompletely healed. B. Live cankered trees, healed (injury not visible before cutting). C. Dead cankered trees.